氏　　名	長谷部　明弘
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学位授与の題目	Magmatic products within the mantle wedge: examples from the Iwanai-dake peridotite and the Oman ophiolite （マントルウェッジにおけるマグマ由来物質：岩内岳かんらん岩体とオマーンオフィオライトの例）
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学位論文要旨

要約

In order to understand the magmatic process within the mantle wedge, two independent studies of mantle-derived peridotites were carried out. One is an example of the peculiar chromitite from the Iwanai-dake peridotite complex, Hokkaido Japan. This is a first report of the chromitite composed of unmixing-textured spinel from the mantle-derived peridotite. The chromitite study provides new evidence of highly oxidized magmatism in the mantle. The other is an example of a harzburgite-dunite-orthopyroxenite suite in the mantle section of the Oman ophiolite. The suite indicates the relation between residue and generated magma within the wedge mantle, which show that the suite is a fragment of the arc-related mantle.

学位論文要旨

In order to understand the magmatic process within the mantle wedge, two independent studies of mantle peridotites were carried out. The studies provide lines of evidence for highly oxidized condition and relation between residue and the generated magma within the mantle wedge. One is the example of the peculiar chromitite from the Iwanai-dake peridotite complex, Hokkaido Japan. This is the first report of the chromitite composed of unmixing-textured spinel from the mantle-derived peridotite. The other is an example of a harzburgite-dunite-orthopyroxenite suite in the mantle section of the Oman ophiolite. This study shows that the suite corresponds to the arc-related mantle of the Oman ophiolite.

Spinel ((Mg, Fe^{2+})(Cr, Al, Fe^{3+})$_2O_4$) with an inhomogeneous texture was observed in a chromitite section (IWD580) from the Iwanai-dake peridotite complex, which mainly consists of highly depleted alpine-type peridotite. The chromitite layer is enveloped by dunite. The inhomogeneous spinel only occurs in the chromitite and adjacent dunite whereas spinel in the surrounding dunite and harzburgite is homogeneous. The inhomogeneous spinel identified under reflected-light microscopy has speckled and symplectic textures. The textures comprise two different spinel phases; a MgAl-rich spinel and a Fe-rich spinel with wide variation of Cr content. I also examined the sample of Nagata (1982) which has been reported as "magnesioferrite and olivine rock" from the Iwanai-dake complex. I found the same mineralogical feature of spinel in the Nagata (1982) sample. The compositional relationships of contiguous phases of the inhomogeneous spinel in both samples correspond to the solvus at 600 °C, which suggest that the spinel inhomogeneity was formed by the unmixing process due to the miscibility gap between Al-rich and Fe^{3+}-rich phases. The variation of the spinel unmixing texture can be explained by compositional differences of original spinel before unmixing. The original spinel composition in the chromitite layer, estimated from bulk spinel composition, is intermediate between magnesioferrite ($MgFe^{3+}{}_2O_4$) and magnetite ($Fe^{2+}Fe^{3+}{}_2O_4$). Such a Fe^{3+}-rich spinel composition indicates that the chromitite was formed under highly oxidized conditions at magmatic temperatures. The highly oxidized hydrous silicate melt, such as minette or absarokite magma, generated by melting of hydrous mantle, possibly reacted with peridotite within the mantle wedge and formed the chromitite mainly composed of Fe^{3+}-rich spinel.

The example of the harzburgite-dunite-orthopyroxenite suite from the West Jizi block in the northern Oman ophiolite shows the relationship between the residue and magma product within the wedge mantle. The orthopyroxenite has dyke-like features, being in direct contact with the host harzburgite. The thickness of orthopyroxenite dyke is 10-30 cm. The orthopyroxenite is composed of orthopyroxene (95~ vol%), cpx (~5 vol%) and trace spinel (~1 vol%), and is free from olivine. The pyroxenite does not exhibit deformation texture whereas the host harzburgite has the porphyroclastic texture. All rocks from the suite are characterized by high Cr# (=Cr/(Cr+Al)) of spinel (Cr# $\geq$ 0.65). The Fo content of olivine is relatively low ($Fo_{89.9\text{-}91.1}$) in harzburgite and dunite. The orthopyroxenite is probably a product of magma injection and crystal fractionation. The petrography and mineral compositions of the orthopyroxenite suggest that the magma is boninitic. The depleted

feature of host harzburgite was caused by re-melting under hydrous condition and correspond a residue after boninitic magma extraction. The rare earth element (REE) pattern of clinopyroxene in the harzburgite is explained by an open-system melting with an influx of light-REE enriched melt and/of fluid.

学位論文審査結果の要旨

長谷部（＝田村）明弘君の本提出論文に対して，予備的な審査の後，平成16年8月3日に口頭発表および審査委員会を行い，以下の結論を得た．

マントルウェッジの理解は，島弧 - 背弧海盆系の成因や発達を理解する上で必要不可欠である．長谷部君はマントルウェッジのマグマ生成物である，岩内岳かんらん岩体の高い酸素フュガシティーの下で生成された特異な岩石（Fe^{3+} に富むクロミタイト）およびオマーンオフィオライトの島弧マントル物質の記載と成因解釈を行っている．彼の得た重要な成果は以下3点である．(1) Fe^{3+} に富むクロミタイトのスピネルの特異な離溶組織を解明した．(2) このクロミタイトが交代作用起源ではなく，著しく酸化的なマグマの固結物であることは明らかにした．(3) オマーンオフィオライトのマントル部分に確実なマントルウェッジ起源の物質を見い出した．

マントルウェッジは一般に酸化的であるとされているが，その原因については不明である．長谷部君の指摘した Fe^{3+} に富むクロミタイトの生成に関与した著しく酸化的なマグマの成因は，その解明への鍵を与えるものとして注目される．オマーンオフィオライトはその起源や形成史に謎が多く，長谷部君の発見はそのマントル部分のマントルウェッジ起源に対して，決定的な証拠を与えるものであり特筆される．一部に詰めの甘い点が残されているものの，本論分の成果は極めてユニークであり，地球科学の進展に資するところが大きい．よって，本論文が博士（理学）の学位を与えるに十分値するものと判断する．